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Certified by

Jon W Dudas

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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Additional inventors are being named on the 1 *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

SURFACTANT ENHANCED FLUID CATALYTIC CRACKING PROCESS

Direct all correspondence to: CORRESPONDENCE ADDRESS

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ENCLOSED APPLICATION PARTS *(check all that apply)*

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☐ Application Date Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.

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☑ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are:

Respectfully submitted,

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Date August 25, 2004

REGISTRATION NO. 48,227
(if appropriate)
Docket Number: JJK-0413 (P2003J083)

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Docket Number	JJK-0413 (P2003J083)

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Number 1 of 1

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PROVISIONAL APPLICATION FOR UNITED STATES PATENT

TITLE: SURFACTANT ENHANCED FLUID CATALYTIC CRACKING PROCESS

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SURFACTANT ENHANCED FLUID CATALYTIC CRACKING PROCESS

FIELD OF THE INVENTION

[0001] The present invention relates generally to the atomization of fluids. More particularly, the invention is concerned with enhancing the atomization of fluids, especially fluidized cat cracker (FCC) feeds, by using a surfactant to alter the interfacial tension between the fluid and atomizing media.

BACKGROUND OF THE INVENTION

[0002] Atomizing a fluid by passing it through an orifice into a lower pressure zone to produce a spray of droplets is a technique used in a wide variety of applications and processes. For example, in fluidized catalytic cracking (FCC) processes relatively viscous petroleum feeds are converted into more valuable products including gasoline, jet fuel, and heating oil. In a FCC process, a preheated oil feed is mixed with steam and the resulting two-phase fluid is passed into a lower pressure atomization zone in which the oil is atomized and brought into contact with a particulate, hot, cracking catalyst whereby the feed is converted into lower boiling products.

[0003] The trend in FCC technology has been to use more active catalysts thereby reducing the length of time the feed needs to be in contact with the catalyst. To take advantage of a short contact time, however, the oil needs to be uniformly distributed in the form of small droplets. Indeed, experience has shown that long oil vaporization times lead to higher yields of undesirable, low value products. Additionally, as feeds become heavier the fraction of steam dispersion gas must be increased to facilitate atomization. Many FCC units, however, have limited steam capacity, which constrains their ability to effectively process heavier feeds.

Considerable effort therefore has been devoted to try to find improved ways for atomizing the oil feed in FCC processes. Examples of such are found in, for example, U.S. Patent 5,289,976, U.S. Patent 5,173,175, U.S. Patent 6,093,310 and U.S. Patent 6,352,639 B2.

[0004] Despite the advances made in atomization hardware, and especially FCC feed injection hardware, it would be an improvement in the art if a way could be found to enhance oil atomization in conjunction with hardware and process constraints.

SUMMARY OF THE INVENTION

[0005] The present invention is directed a surfactant-enhanced atomization process. The process comprises:

a) mixing an effective amount of at least one surfactant with an atomization fluid to form a first mixture;

b) injecting said first mixture into a fluidized catalytic cracking feedstream to form a second mixture; and

c) conducting said second mixture through a feed nozzle.

[0006] In another embodiment, the present invention comprises:

a) mixing an effective amount of at least one surfactant with an atomization fluid to form a first mixture;

b) injecting said first mixture into a fluidized catalytic cracking feedstream to form a second mixture;

c) conducting said second mixture through a feed nozzle into a fluidized catalytic cracking reaction zone, thereby producing droplets of the second mixture and injecting them into the reaction zone; and

d) contacting the droplets of the second mixture with a FCC catalyst under effective catalytic cracking conditions in the reaction zone thereby producing at least an FCC product stream comprising at least C_{2-} dry gas and spent catalyst comprising strippable hydrocarbons.

[0007] In one embodiment of the present invention, the effective amount of the at least one surfactant is that amount sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream, relative to the amount of C_{2-} dry gas in the FCC product stream in the absence of the surfactant.

[0008] In yet another embodiment, the instant invention further comprises:

a) fractionating said FCC product stream to produce at least a naphtha boiling range product stream.

[0009] In another embodiment of the present invention, the effective amount of the at least one surfactant is that amount sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream without causing foaming in the FCC unit.

[0010] In yet another embodiment of the present invention, the effective amount of the at least one surfactant is that amount sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream without causing foaming, haze, or increasing the oxygenate content of the naphtha boiling range product.

DETAILED DESCRIPTION OF THE INVENTION

[0011] The present invention is directed a surfactant-enhanced fluid catalytic cracking process. In the practice of the present invention, an effective amount of at least one surfactant is mixed with an atomization fluid to form a first mixture. The first mixture is subsequently injected into a fluidized catalytic cracking ("FCC") feedstream to form a second mixture, which is conducted through a feed nozzle. In one embodiment of the present invention, the invention further comprises conducting the second mixture through a feed nozzle into a fluidized catalytic cracking reaction zone, thereby producing droplets of the second mixture and injecting them into a reaction zone. In the reaction zone, the droplets of the second mixture are contacted with a FCC catalyst under effective cracking conditions to produce at least an FCC product stream and spent catalyst comprising strippable hydrocarbons.

[0012] As stated above, in practice of the present invention, an effective amount of at least one surfactant is mixed with an atomization fluid to form a first mixture. Any surfactant that can reduce the static and dynamic interfacial tension between an FCC feedstream and an atomizing fluid may be used. Preferred surfactants suitable for use in the present invention are any of those surfactants known to be thermally stable under feed preheating but will decompose under the effective cracking conditions used herein. Preferably, the at least one surfactant does not contain components containing sulfur, nitrogen and metals. Non-limiting examples of suitable surfactants include non-ionic surfactants and mixtures thereof having hydrophilic lipophilic balance values (HLBs) in the range of about 3 to about 20. Non-limiting examples of such surfactants include alkyl alkoxylates, preferably alkyl ethoxylates, mixtures of aldehydes and ketones, preferably alkyl aldehyde acids and ketones, more preferably alkyl aromatic aldehydes and ketones and acids.

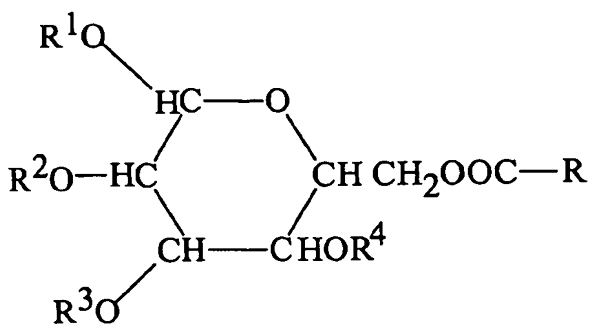
[0013] The atomizing fluid may comprise subcooled water (water having a temperature above its normal atmospheric pressure boiling point at pressure sufficient to maintain it in a liquid state), steam, light hydrocarbon gas (C_4-), inert gases and/or combinations thereof. Light hydrocarbon gases include, but are not limited to methane, ethane, ethylene, acetylene, propane, propylene, propyne, butane and butenes and combinations thereof. Inert gases as used herein include, but are not limited to, helium, hydrogen, nitrogen, argon, and other suitable inert gases and combinations thereof. It is preferred that the atomizing fluid be steam.

[0014] The first mixture, i.e. the mixture of surfactants and atomizing fluid, may be prepared either by any one or a combination of methods. Non-limiting examples of preparing the first mixture include adding the surfactant to the atomizing fluid, vaporizing the surfactant and introducing the vaporized surfactant into the atomizing fluid, and adding the surfactant to water and heating the surfactant solution to provide a steam and surfactant mixture.

[0015] If steam is the atomization fluid, alkyl alkoxylate type surfactants are particularly suitable at treat rates in the range of about 25 ppm to 50,000 ppm based on the weight of steam, and preferably in the range of 50 to 10,000 ppm. Especially preferred are alkyl alkyloxylates represented by formulae I to III:

$$RO(R^5O)_nH \qquad \text{I}$$

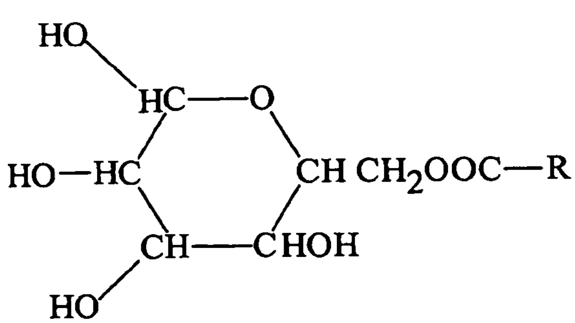
$$R\text{—}CO(R^5O)_nH \qquad \text{II}$$



III

where R is a linear or branched alkyl group of about 3 to 24 carbon atoms; R^1, R^2, R^3 and R^4 are independently alkoxylate groups, $(R^5O)_mH$ where R^5 is an alkylene group of about 2 to 4 carbon atoms and m is from about 1 to 20, preferably from about 1 to 15, more preferably about 1 to 5, and more preferably about 1 to 3.

[0016] When surfactants have a formula according to surfactant III above are used, it is preferred to use it in combination with an alkyl sorbitan of structure IV.



IV

[0017] For the alkyl sorbitan it is preferred R is an alkyl group of 3 to 24 carbon atoms. When used in combination with surfactant III the ratio of surfactant III/IV is preferably between about 95/5 to 30/20 and more preferably about 80/20 to 30/70 and even more preferably 75/25 to 50/50.

[0018] It should be noted that any surfactants of the type I, II, III and IV discussed above may be used, alone or in mixtures. It should also be noted that in some instances, an FCC feedstream containing a suitable surfactant can also be used. In this embodiment, when the FCC feedstream is provided with the surfactant or mixture of surfactants, the amount of surfactant generally is in the range of 50 to 20,000 ppm based on the weight of the FCC feedstream, preferably in the range of 50 to 5,000 ppm. Alternatively, a petroleum oil containing alkyl substituted 1, 2 and 3 ring aromatic compounds may be oxidized to generate a suitable mixture of oxidized products suitable as additives for the invention. The oxidization is conducted by heating the oil from about 150°C to about 200°C, in the presence of air for a time sufficient, typically about 4 hours, to produce the oxidized products suitable as additives for the invention. Typically such oxidation produces aldehydes, ketones and acids.

[0019] In the practice of the present innovation, the first mixture is subsequently injected into a fluidized catalytic cracking feedstream to form a second mixture. The method of injecting the first mixture into the FCC feedstream is not critical to the instant invention and can be accomplished by any means known for injecting an atomizing fluid into a hydrocarbonaceous material. Non-limiting examples of suitable injection methods include mixing tees, spargers, and injection devices.

[0020] Any conventional FCC feed can be used in the present invention. Such feeds typically include heavy hydrocarbonaceous feeds boiling in the range of about 430°F to about 1050°F (220-565°C), such as gas oils, heavy hydrocarbon oils comprising materials boiling above 1050°F (565°C); heavy and reduced petroleum crude oil; petroleum atmospheric distillation bottoms; petroleum vacuum

distillation bottoms; pitch, asphalt, bitumen, other heavy hydrocarbon residues; tar sand oils; shale oil; liquid products derived from coal liquefaction processes; and mixtures thereof. The FCC feed may also comprise recycled hydrocarbons, such as light or heavy cycle oils.

[0021] As stated above, an effective amount of a surfactant is mixed with an atomizing fluid to form the first mixture that is injected into the FCC feedstream. As used herein, an effective amount of a surfactant is to be considered that amount of surfactant capable of reducing the static and dynamic interfacial tension between the FCC feedstream and atomizing fluid. In a preferred embodiment, an effective amount of surfactant is about 25 to about 50,000 wppm, based on the atomization fluid, more preferably about 25 to about 10,000, most preferably about 25 to about 5,000. Reducing the interfacial tension results in a narrow distribution of small droplets of the second mixture when it is conducted through the feed nozzle. Small droplet sizes increases the vaporization rate of the second mixture and provides better contacting with catalysts. For example, a 25% reduction in the mean oil droplet diameter boosts vaporization rate by 35% to 50%, and shorter vaporization times typically improve the yield of desirable products. Thus, it is preferred that an effective amount of surfactant be that amount effective at reducing the static and dynamic interfacial tension between the FCC feedstream and atomizing fluid by at least 50%. Preferably, an effective amount of surfactant or mixture of surfactants will be that amount sufficient to reduce the static and dynamic interfacial tension between the FCC feedstream and atomizing fluid such that the droplets formed by conducting the second mixture through a feed nozzle have a mean droplet diameter less than about 1000 μ, preferably less than 500 μ.

[0022] In one embodiment of the present invention, the above-described second mixture is conducted through a feed nozzle into a fluidized catalytic cracking reaction zone. The droplets of the second mixture, having the above-described droplet size, are contacted with a FCC catalyst under effective catalytic cracking conditions in the reaction zone. In this embodiment, any FCC cracking catalyst can be used. Effective cracking conditions include: (i) temperatures from about 500°C to about 650°C, preferably from about 525°C to 600°C; (ii) hydrocarbon partial pressures from about 10 to 40 psia (70-280 kPa), preferably from about 20 to 35 psia (140-245 kPa); and, (iii) a catalyst to feed (wt/wt) ratio from about 1:1 to 12:1, preferably from about 4:1 to 10:1, where the catalyst weight is the total weight of the catalyst composite. The contacting of the second mixture and the FCC catalyst produces at least an FCC product stream comprising at least C_{2-} dry gas and spent catalyst comprising strippable hydrocarbons. It should be noted that C_{2-} dry gas as used herein is meant to refer to the gasses produced by the FCC cracking reaction that have a chemical makeup and boiling point range of C_2 and below, i.e. methane, ethane, H_2, $C_2=$ such as ethylene, etc. Thermal cracking produces increased amounts of dry gas while effective catalytic cracking produces less C_{2-} dry gas than thermal cracking. An efficient FCC produces lower amounts of C_{2-} dry gas by promoting increased catalytic cracking and decreased thermal cracking. Thus, the efficiency of the present process is noted by a reduction in C_{2-} dry gas in the FCC product stream. In this embodiment, an effective amount of surfactant is further to be considered an amount of surfactant sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream.

[0023] As discussed above, another embodiment of the instant invention involves fractionating the FCC product stream to produce at least a naphtha boiling range product stream. As used herein, a naphtha boiling range product is meant to

refer to hydrocarbon streams boiling in the range of about 50°F (10°C) to about 450°F (232°C). The method by which the FCC product stream is fractionated is not critical to the instant invention, and any type of fractionation known can be used. For example, atmospheric or vacuum distillation may be employed in fractionating the FCC product stream. In this embodiment an effective amount of surfactant is further defined as that amount of surfactant sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream without causing foaming, haze, or increasing the oxygenate content of said naphtha boiling range product stream. Controlling the haze, etc. of the naphtha boiling range product stream is important because it is typically used as a blending component for motor gasolines. It should be noted that haze is typically a result of water entrapment in the naphtha boiling range product.

[0024] Also, as discussed above, another embodiment of the instant invention an effective amount of surfactant is further defined as that amount of surfactant sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream without causing foaming in the FCC process unit.

[0025] The above description is directed to several embodiments of the present invention. Those skilled in the art will recognize that other embodiments that are equally effective could be devised for carrying out the spirit of this invention.

[0026] The following examples will illustrate the improved effectiveness of the present invention, but are not meant to limit the present invention in any fashion.

EXAMPLES

[0027] The effectiveness of using a surfactant in the atomization fluid of a Fluidized Catalytic Cracking ("FCC") unit was tested in a nominal 20 kB/D unit. For a period of five days, a surfactant was added in various treat rates under a combination of conditions and with a variety of feeds in order to determine the effect the surfactant would have on the FCC process. The Examples below represent the five days that the surfactant was added to the atomization steam of the FCC.

EXAMPLE 1

[0028] Neodol 91-2.5E, a primary alcohol ethoxylate surfactant commercially available from Shell Chemicals was added to atomization steam in an amount of 1000 wppm, based on the atomization steam mass flow rate. This surfactant-enhanced atomization steam was used to atomize an FCC feed whose properties are listed below:

Gravity, API	19.1
Carbon, wt%	84.7
Hydrogen, wt%	11.57
Nitrogen, wppm	1504
Sulfur, wt%	2.964
5% / 50% / 95% BP (wt)	516 / 798 / 990°F

[0029] The injection of additized steam continued for a period of 2 to 3 hours. During this test period the FCC unit was operated under constant conditions including an oil feed rate of 16.9 kbbl/day, 3.7 klb/hr atomization steam, riser outlet temperature of 1005°F, and a catalyst to oil weight ratio of 9.5 lbs. catalyst/lb. of oil.

[0030] During the test run, FCC dry gas samples obtained from the FCC unit were analyzed by gas chromatography, and light cat naphtha ("LCN") having a nominal boiling point range of C_5 - 320°F was collected and analyzed for foaming, haze, and oxygenate content by ASTM D-4815 and confirmed by GC/MS analysis. These analyses showed low ppm levels of alcohols and ketones at the detection limit and virtually the same in LCN samples before and after surfactant addition. The foaming test was conducted by vigorously shaking about 100 ml of the LCN in a 150ml tube for 3 minutes. The agitated LCN was allowed to stand for 1 minute and the initial foam height and time of foam collapse (foam stability) were determined. Base line samples with no surfactant and samples obtained during surfactant addition showed no difference in foam height or foam stability. The LCN was analyzed for haze by visual examination of the sample. Base line samples with no surfactant and samples obtained during surfactant addition showed no difference in haze. A sample of the FCC feed (containing the surfactant-enhanced atomization fluid) was also analyzed by for interfacial tension. About a 5% reduction in each hydrogen, ethane, and ethylene in dry gas samples was observed during the surfactant addition period.

EXAMPLE 2

[0031] The same Neodol 91-2.5E primary alcohol ethoxylate surfactant used in Example 1 was added to atomization steam in an amount of 2000 wppm, based on the steam mass flow rate. This surfactant-enhanced atomization fluid was used to atomize a FCC feed with the following properties:

Gravity, API	19.0
Carbon, wt%	86.41
Hydrogen, wt%	11.73
Nitrogen, wppm	1510
Sulfur, wt%	2.92
5% / 50% / 95% BP (wt)	513 / 796 / 991 °F

[0032] The injection of additized steam continued for a period of 2 to 3 hours. During this period, the FCC unit was operated under constant conditions including an oil feed rate of 16.9 kbbl/day of feed, 3.7 klb/hr atomization steam, riser outlet temperature of 990°F, and a catalyst to oil weight ratio of 9.5 lbs. catalyst/lb. of oil.

[0033] During the test run, FCC dry gas samples obtained from the FCC unit were analyzed by gas chromatography, and light cat naphtha ("LCN") having a nominal boiling point range of C_5 - 320°F was collected and analyzed for foaming, haze, and oxygenate content. The foaming, oxygenate content, and haze were determined according to the methods outlined in Example 1 above. A Sample of the FCC feed (containing the surfactant-enhanced atomization fluid) was also analyzed for interfacial tension. About 5% reduction in each methane, ethane, and ethylene in dry gas samples was observed during the surfactant addition period.

EXAMPLE 3

[0034] The same Neodol 91-2.5E primary alcohol ethoxylate surfactant used in Example 1 was added to atomization steam in an amount of 5000 wppm, based on the steam mass flow rate. This surfactant-enhanced atomization fluid was used to atomize an FCC feed with the following properties:

Gravity, API	18.7
Carbon, wt%	85.1
Hydrogen, wt%	11.67
Nitrogen, wppm	1663
Sulfur, wt%	2.979
5% / 50% / 95% BP (wt)	511 / 804 / 1003 °F

[0035] The injection of additized steam continued for a period of 2 to 3 hours. During this test period, the FCC unit was operated under constant conditions including an oil feed rate of 16.9 kbbl/day of feed, 3.7 klb/hr atomization steam, riser outlet temperature of 990°F, and a catalyst to oil weight ratio of 9.5 lbs. catalyst/lb. of oil.

[0036] During the test run, FCC dry gas samples obtained from the FCC unit were analyzed by gas chromatography, and light cat naphtha ("LCN") having a nominal boiling point range of C_5 - 320 °F was collected and analyzed for foaming, haze, and oxygenate content. The foaming, oxygenate content, and haze were determined according to the methods outlined in Example 1 above. A Sample of the FCC feed (containing the surfactant-enhanced atomization fluid) was also analyzed for interfacial tension. About 5% reduction in each hydrogen, ethane, ethylene, propane, and propylene was observed during the surfactant addition period.

CLAIMS:

1. A surfactant-enhanced atomization process comprising:
   a) mixing an effective amount of at least one surfactant with an atomization fluid to form a first mixture;
   b) injecting said first mixture into a fluidized catalytic cracking feedstream to form a second mixture; and
   c) conducting said second mixture through a feed nozzle.

2. The process according to claim 1 wherein said effective amount of surfactant is that amount of surfactant capable of reducing the static and dynamic interfacial tension between the fluidized catalytic cracking feedstream and atomizing fluid.

3. The process according to claim 1 wherein said effective amount of surfactant is about 25 to about 50,000 wppm, based on the atomization fluid.

4. The process according to claim 2 wherein said at least one surfactant is selected from those surfactants which, under fluidized catalytic cracking feed preheating do not decompose, but will decompose under the effective cracking conditions.

5. The process according to claim 2 wherein said at least one surfactant is selected from non-ionic surfactants and mixtures thereof having hydrophilic lipophilic balance values ("HLBs") in the range of about 3 to about 20.

6. The process according to claim 2 wherein said at least one surfactant is selected from alkyl alkoxylates.

7. The process according to claim 1 wherein said atomizing fluid is selected from subcooled water (water having a temperature above its normal atmospheric pressure boiling point at pressure sufficient to maintain it in a liquid state), steam, light hydrocarbon gas (C_4-), inert gases and combinations thereof.

8. The process according to claim 5 wherein the atomizing fluid is steam.

9. The process according to claim 1 wherein said process further comprises:
   a) conducting said second mixture through a feed nozzle into a fluidized catalytic cracking reaction zone, thereby producing droplets of the second mixture and injecting them into a reaction zone; and
   b) contacting the droplets of the second mixture with a fluidized catalytic cracking catalyst under effective catalytic cracking conditions in the reaction zone thereby producing at least an FCC product stream comprising at least C_{2-} dry gas and spent catalyst comprising strippable hydrocarbons.

10. The process according to claim 9 wherein an effective amount of said at least one surfactant is that amount sufficient to reduce the static and dynamic interfacial tension of the fluidized catalytic cracking feedstream and atomizing fluid such that droplets of the second mixture formed by conducting the second mixture through said feed nozzle have a mean droplet diameter less than about 1000 μ.

11. The process according to claim 9 wherein said effective cracking conditions include: (i) temperatures from about 500°C to about 650°C, (ii) hydrocarbon partial pressures from about 10 to 40 psia (70-280 kPa); and, (iii) a catalyst to feed (wt/wt) ratio from about 1:1 to 12:1, where the catalyst weight is based on the total weight of the catalyst composite.

12. The process according to claim 10 wherein said effective amount of surfactant is that amount sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream.

13. The process according to claim 10 wherein said process further comprises fractionating said FCC product stream to produce at least a naphtha boiling range product stream.

14. The process according to claim 1 wherein said fluidized catalytic cracking feedstream is selected from gas oils, heavy hydrocarbon oils comprising materials boiling above 1050°F (565°C); heavy and reduced petroleum crude oil; petroleum atmospheric distillation bottoms; petroleum vacuum distillation bottoms; pitch, asphalt, bitumen, other heavy hydrocarbon residues; tar sand oils; shale oil; liquid products derived from coal liquefaction processes; and mixtures thereof.

15. The process according to claim 1 wherein said effective amount of surfactant is that amount effective at reducing the static and dynamic interfacial tension between the FCC feedstream and atomizing fluid by at least 50%.

16. The process according to claim 13 wherein said effective amount of surfactant is that amount of surfactant sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream.

17. The process according to claim 16 wherein said effective amount of surfactant is that amount of surfactant sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream without causing foaming in the FCC process unit.

18. The process according to claim 16 wherein said effective amount of surfactant is that amount of surfactant sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream without causing foaming, haze, or increasing the oxygenate content of said naphtha boiling range product stream.

19. A surfactant-enhanced fluid catalytic cracking process comprising:

a) mixing an effective amount of a surfactant with an atomization fluid selected from subcooled water (water having a temperature above its normal atmospheric pressure boiling point at pressure sufficient to maintain it in a liquid state), steam, light hydrocarbon gas (C_4-), inert gases and/or combinations thereof to form a first mixture;

b) injecting said first mixture into a fluidized catalytic cracking feedstream to form a second mixture;

c) conducting said second mixture through a feed nozzle into a fluidized catalytic cracking reaction zone, thereby producing droplets of the second mixture and injecting them into a reaction zone; and

d) contacting the droplets of the second mixture with a FCC catalyst under effective catalytic cracking conditions in the reaction zone

thereby producing at least an FCC product stream comprising at least C_{2-} dry gas and spent catalyst comprising strippable hydrocarbons;

wherein said effective amount of surfactant is that amount of surfactant capable of reducing the static and dynamic interfacial tension between the fluidized catalytic cracking feedstream and the atomizing fluid.

20. The process according to claim 19 wherein said effective amount of surfactant is about 25 to about 50,000 wppm, based on the atomization fluid.

21. The process according to claim 20 wherein said at least one surfactant is selected from those surfactants known which, under fluidized catalytic cracking feed preheating do not decompose, but will decompose under the effective cracking conditions.

22. The process according to claim 20 wherein said at least one surfactant is selected from non-ionic surfactants and mixtures thereof having hydrophilic lipophilic balance values in the range of about 3 to about 20.

23. The process according to claim 22 wherein said at least one surfactant is selected from alkyl alkoxylates, preferably alkyl ethoxylates, mixtures of aldehydes and ketones, preferably alkyl aldehyde acids and ketones, more preferably alkyl aromatic aldehydes and ketones and acids.

24. The process according to claim 19 wherein the atomizing fluid is steam.

25. The process according to claim 24 wherein an effective amount of said at least one surfactant is that amount sufficient to reduce the static and dynamic

interfacial tension of the fluidized catalytic cracking feedstream and atomizing fluid such that droplets of the second mixture formed by conducting the second mixture through said feed nozzle have a mean droplet diameter less than about 1000 μ.

26. The process according to claim 19 wherein said effective cracking conditions include: (i) temperatures from about 500°C to about 650°C, (ii) hydrocarbon partial pressures from about 10 to 40 psia (70-280 kPa); and, (iii) a catalyst to feed (wt/wt) ratio from about 1:1 to 12:1, where the catalyst weight is based on the total weight of the catalyst composite.

27. The process according to claim 24 wherein said effective amount of surfactant is that amount sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream.

28. The process according to claim 19 wherein said process further comprises fractionating said FCC product stream to produce at least a naphtha boiling range product stream.

29. The process according to claim 19 wherein said fluidized catalytic cracking feedstream is selected from gas oils, heavy hydrocarbon oils comprising materials boiling above 1050°F (565°C); heavy and reduced petroleum crude oil; petroleum atmospheric distillation bottoms; petroleum vacuum distillation bottoms; pitch, asphalt, bitumen, other heavy hydrocarbon residues; tar sand oils; shale oil; liquid products derived from coal liquefaction processes; and mixtures thereof.

30. The process according to claim 28 wherein said effective amount of surfactant is that amount of surfactant sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream without causing foaming in the FCC process unit.

31. The process according to claim 28 wherein said effective amount of surfactant is that amount of surfactant sufficient to reduce the amount of C_{2-} dry gas in the FCC product stream without causing foaming, haze, or increasing the oxygenate content of said naphtha boiling range product stream.

SURFACTANT ENHANCED FLUID CATALYTIC CRACKING PROCESS

ABSTRACT

The atomization of a fluid injected into an atomization zone is enhanced by providing the fluid with an effective amount of an additive capable of reducing the static and dynamic interfacial tension of the fluid components.

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